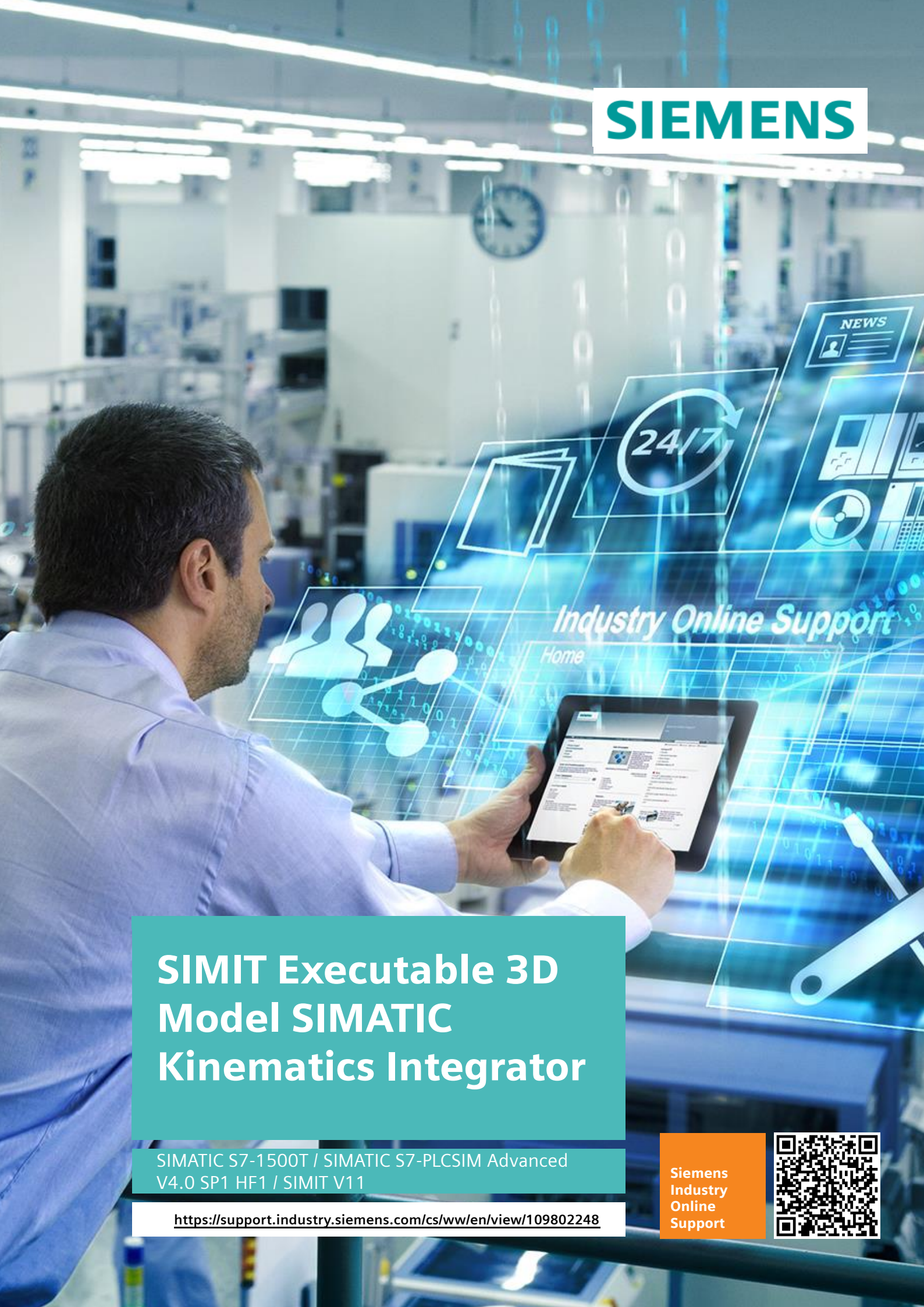

SIMIT Executable 3D Model SIMATIC Kinematics Integrator

SIMATIC S7-1500T / SIMATIC S7-PLCSIM Advanced V4.0 SP1 HF1 / SIMIT V11

https://support.industry.siemens.com/cs/ww/en/view/109802248

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Table of contents

1 Introduction

1.1 Overview

This application example can be used to simulate the SIMATIC S7-1500T SIMATIC Kinematics Integrator standard application with SIMATIC S7-PLCSIM Advanced and SIMIT in combination with a 3D model.

1.2 Components used

This application example has been created with the following hardware and software components:

Table 1-1

Component	Number	Article number
SIMATIC STEP 7 Professional V17 (TIA Portal)	1	6ES7822-1..06-..
PLCSIM Advanced 4.0 SP1 HF1	1	6ES7823-1F.03-0Y.5
SIMIT V11	1	6DL8913-0AL00-0AB5
SIMIT-Unity coupling V3.0.0	1	

This application example consists of the following components:

Table 1-2 Project components

Component	File name	Note
Documentation	Manual_SIMIT_Executable_3D_Model_SKI_V1_0_0.pdf	
STEP 7 project	TIA_Project_3D_Model_SKI_V1_0_0.zap17	Inside “TIA” folder
SIMIT project	SIMIT_Project_3D_Model_SKI_V1_0_0.zip	Inside “SIMIT” folder
3D Model	Executable_3D_Model_SKI_V1_0_0.zip	Inside “3D” folder
SIMIT-Unity coupling	Unity.zip	Inside “Unity” folder

2 Software Setup

After downloading the “SIMIT_Executable_3D_Model_SKI.zip”, it can be unzipped into a desired folder. All included files are shown in Table 1-2.

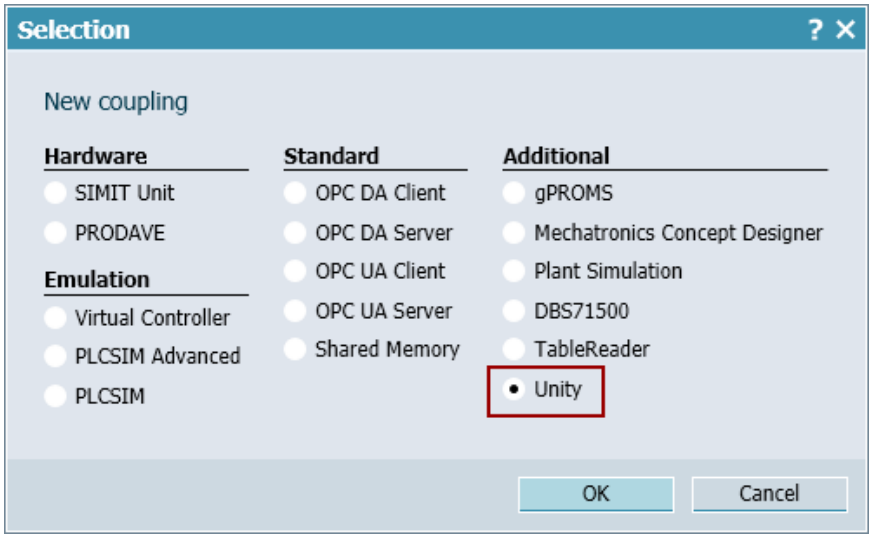
2.1 SIMIT

NOTICE	It is important, that firstly the SIMIT-Unity coupling is configured in SIMIT before the SIMIT project is retrieved and opened for the first time.

2.1.1 Configuring the SIMIT-Unity coupling

The SIMIT-Unity coupling is based on an external coupling for SIMIT and must be added manually. The required steps are described in the following table.

Table 2-1

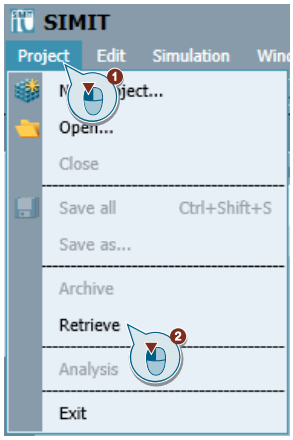
No.	Action
1.	Unzip „Unity.zip“ into a new folder “Unity” in the following directory: …\Siemens\Automation\SIMIT\SIMIT SF\couplings If the folder “couplings” does not exist yet, it needs to be created.
2.	Restart SIMIT to update the couplings dialogue. The new coupling “Unity” is visible in the coupling selection dialogue. 
3.	The SIMIT-Unity coupling was added correctly. The dialogue can be closed with clicking the “Cancel” button.

2.1.2 Retrieve SIMIT project

Before retrieving the SIMIT project, the SIMIT-Unity coupling must be configured (2.1.1).

The SIMIT project is provided as a SIMIT archive. For retrieving the project following steps need to be done.

Table 2-2 Retrieve SIMIT project

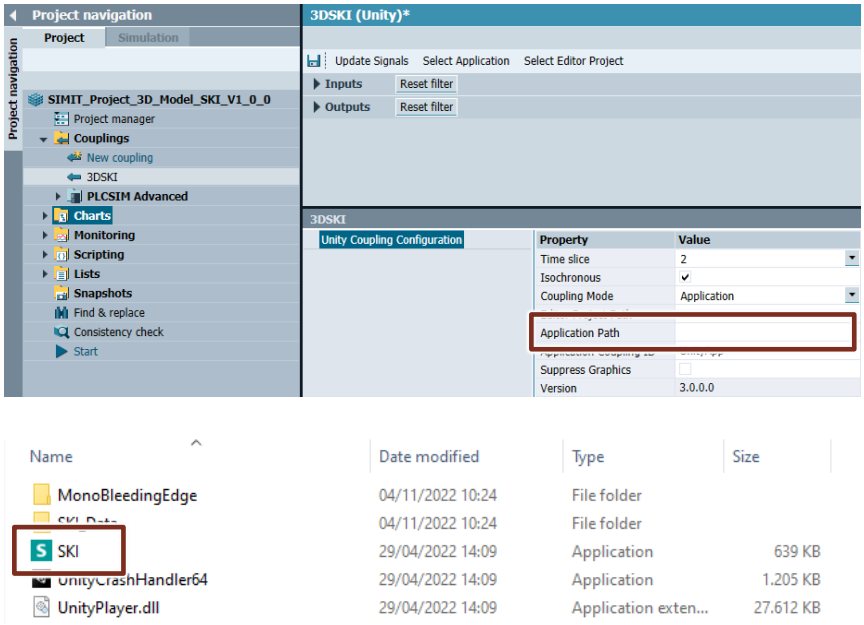
No.	Action
1.	
2.	Under “Archivename” navigate to “SIMIT_Project_3D_Model_SKI_V1_0_0.simarc”. As “Target folder” a desired folder can be selected. 
3.	The following warning can be confirmed with clicking “Yes”.
4.	The project is retrieved.

2.1.3 Executable 3D model

Before starting the simulation, it is needed to add the 3D model into the project. Therefore, the following steps need to be done.

Table 2-3 Adding 3D model

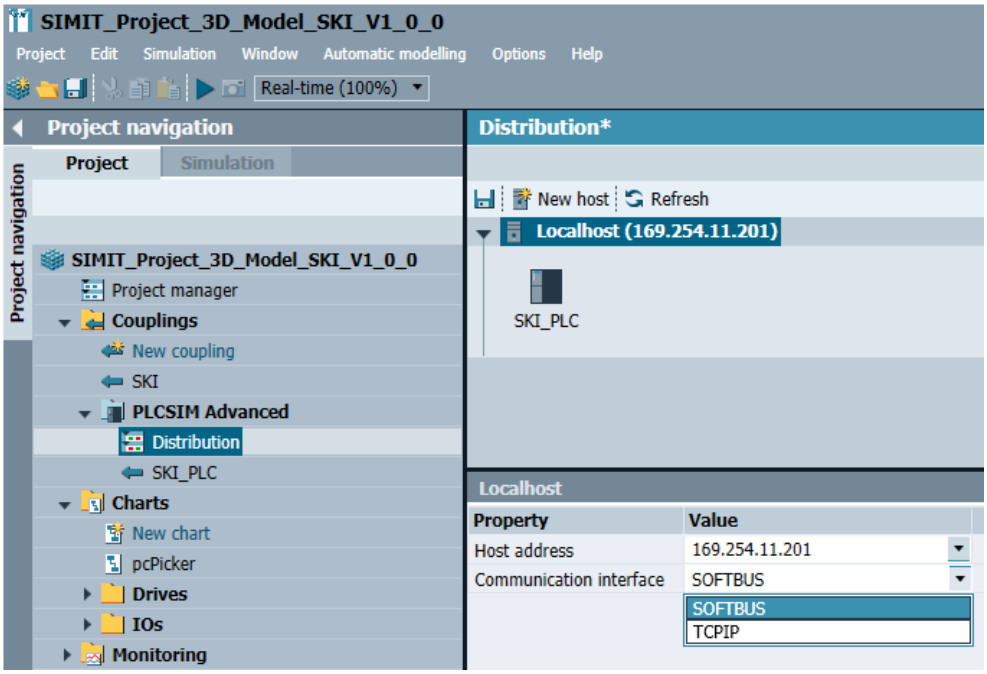
No.	Action
1.	Unzip “Executable_3D_Model_SKI_V1_0_0.zip” into desired folder.
2.	Open existing coupling with double clicking “3DSKI”.

No.	Action
3.	To refresh the “Application Path”, click “Select application”, navigate to the folder from step 1, select “SKI” and click “Open”. 
4.	Confirm the update of the signals with “Yes”.
5.	Check if the coupling is still defined as “Isochronous”.

2.1.4 PLCSIM Advanced coupling

Depending on whether the PLCSIM Advanced Virtual Ethernet Adapter should be used or not, the communication interface in the PLCSIM Advanced coupling needs to be set to “SOFTBUS” (when the PLCSIM Advanced Virtual Ethernet Adapter is **not** used) or to “TCPIP” (when the PLCSIM Advanced Virtual Ethernet Adapter is used).

Figure 2-1 Communication interface



Typically, when TIA Portal and SIMIT run on the same system, “SOFTBUS” is used.

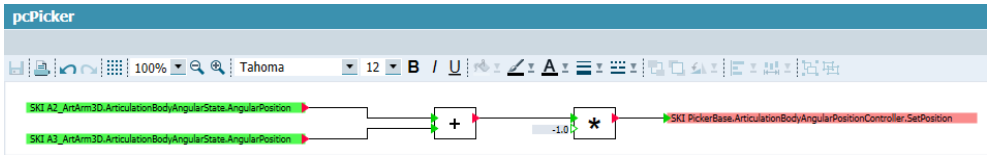
2.1.5 Charts of the SIMIT project

The SIMIT simulation software maps the behavior of active components (e.g. of drives or valves). In SIMIT, you can simulate error scenarios to analyze the behavior of the machine in a virtual space. The required components are organized in individual charts.

pcPicker

This chart calculates the set point position for the axis of the picker base, because this axis is not controlled by the application.

Figure 2-2 Chart pcPicker



Drives

This folder consists of charts for all technology objects that are interconnected with a drive. For cyclic data exchange between the PLC and the drive, PROFIdrive telegram 105 is set up in these charts.

IOs

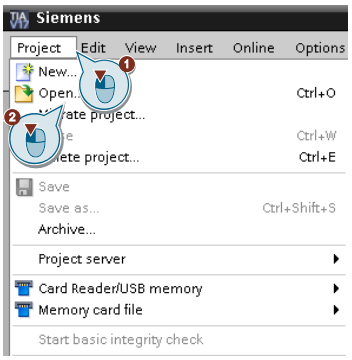
This folder consists of a chart, that does the interconnections between the in- and outputs of the application and the 3D model.

2.2 TIA Portal

2.2.1 Preparing the TIA Portal project

To prepare the provided TIA Portal archived project for the simulation, the following steps need to be done.

Table 2-4 Prepare TIA Portal project

No.	Action
1.	Start TIA Portal, click “Project” and “Open”. 
2.	Browse to the provided TIA Portal compressed project. Define a desired target folder.
3.	Start simulation of HMI.

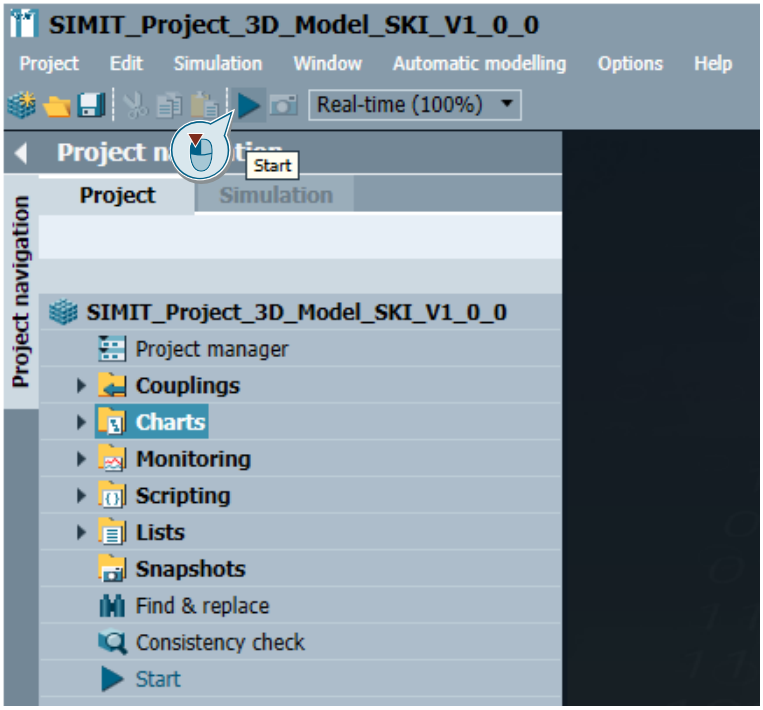
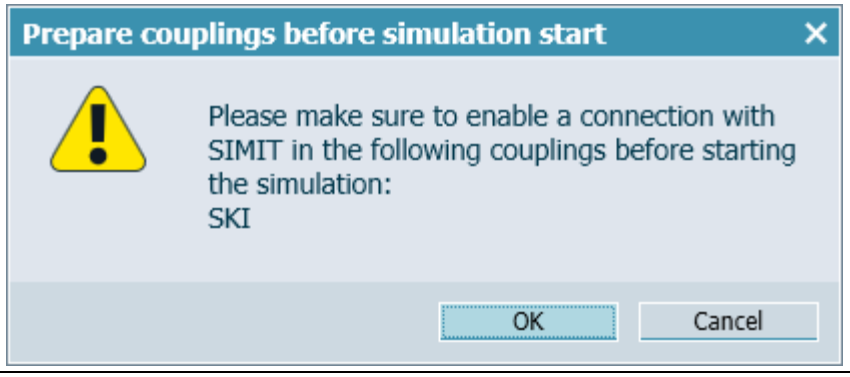
3 Operating the digital twin

3.1 Starting the simulation

NOTE It is important to go through chapter 2 before opening the SIMIT project and starting the simulation.

To start the simulation, following steps need to be done.

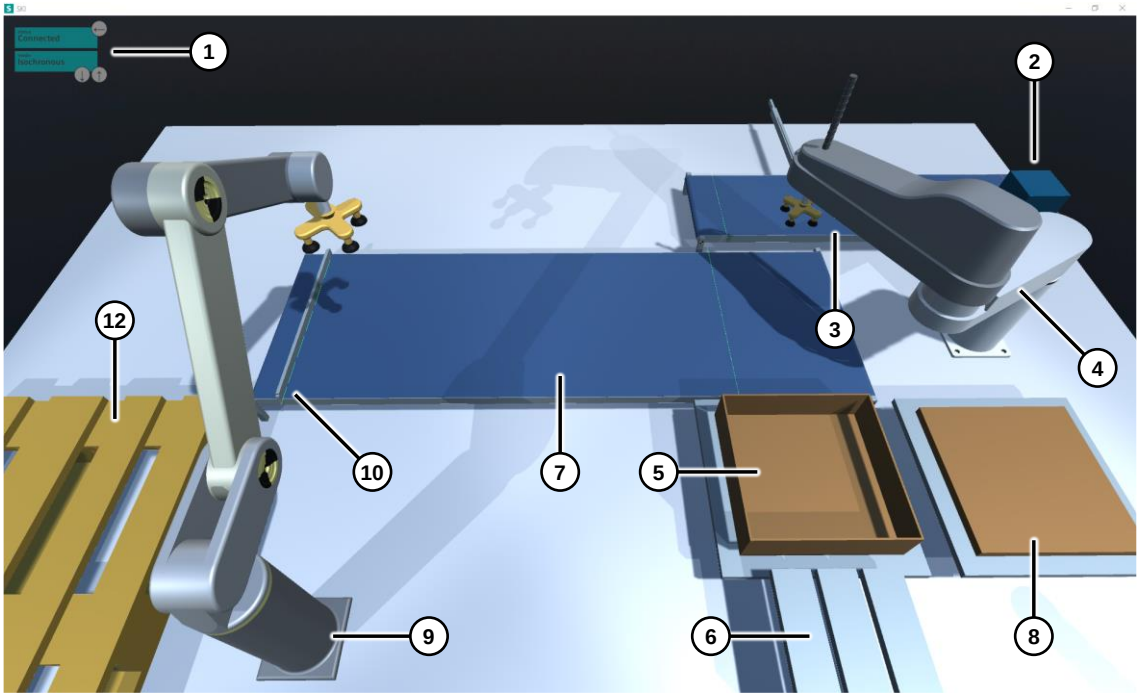
Table 3-1 Starting the simulation

No.	Action
1.	Click „Start“ in SIMIT. 
2.	Confirm the appearing warning with “Ok”. 
3.	Simulation starts with following steps: 1. Starting the S7-PLCSIM Advanced instance 2. Opening and connecting the 3D model 3. Establishing HMI connection
4.	Digital twin is ready for operation.

3.2 Overview of the 3D model

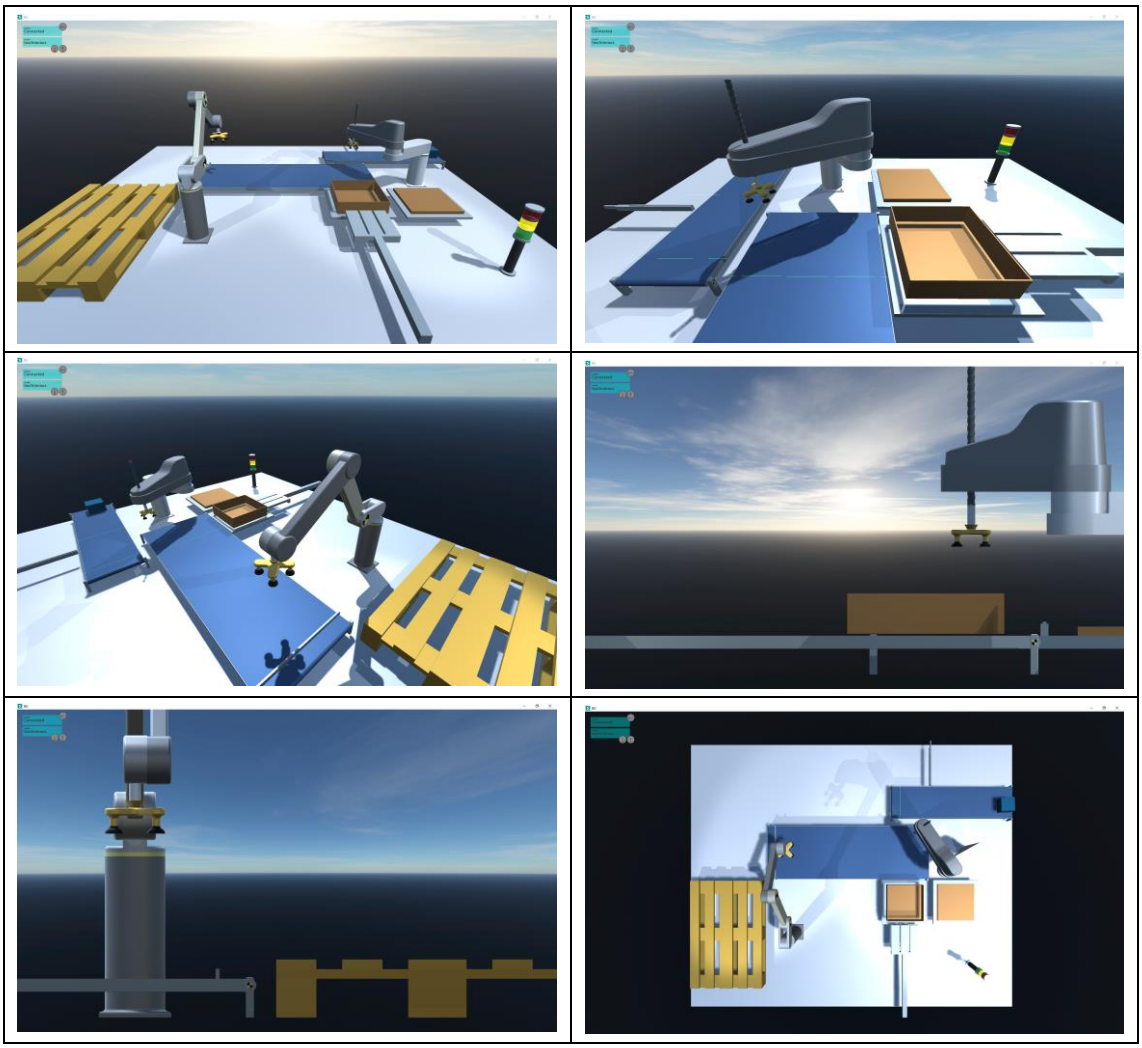
In the top left corner status information about the connection to SIMIT can be found (1). Products spawning at the smaller product belt (2) and are detected by a sensor (3). The Scara roboter (4) picks the products and sort them into a box (5), that is pushed by a loader (6) onto the bigger product belt (7). After 4 products are sorted into the box, the box is closed with a cover (8). The box is moved into the direction of the articulated arm (9) until a sensor (10) detects the box. With the palatizing the box onto the palette (11) the sequence is done. In parallel the next throughput has been started.

Figure 3-1 Overview of the 3D model



The “Space” key on the keyboard switches between 6 different standard views (Table 3-2).

Table 3-2 Standard views

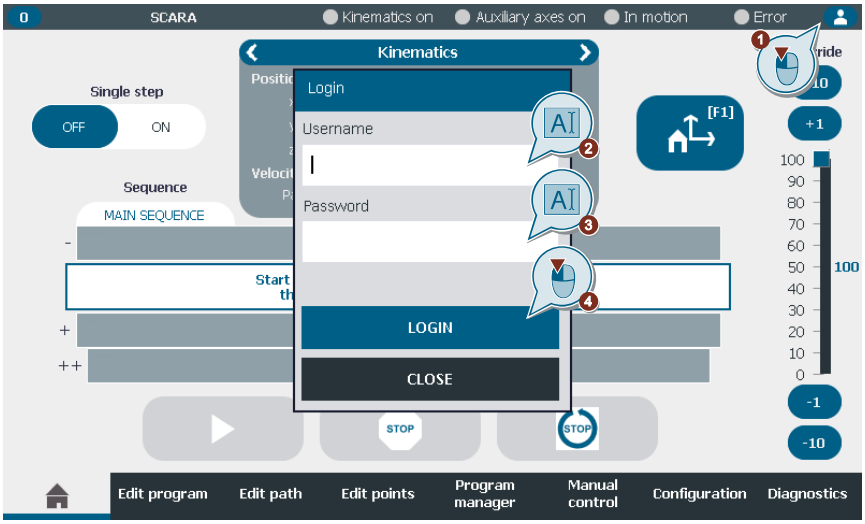
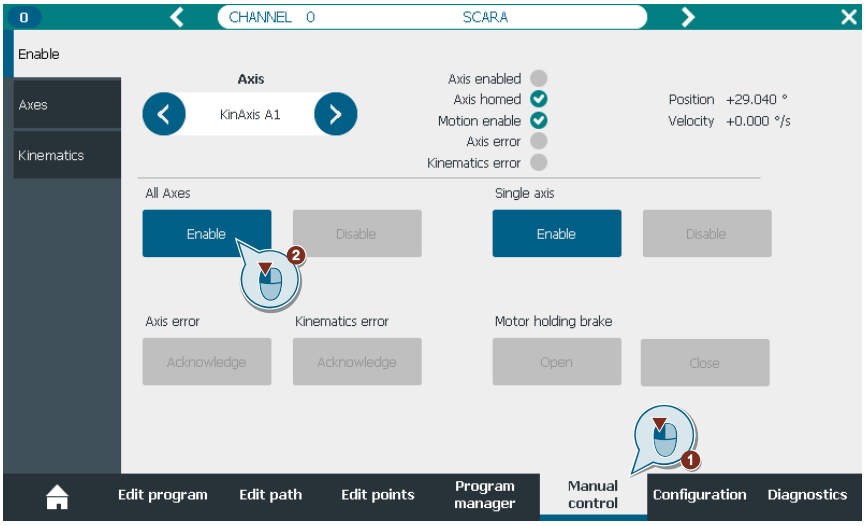


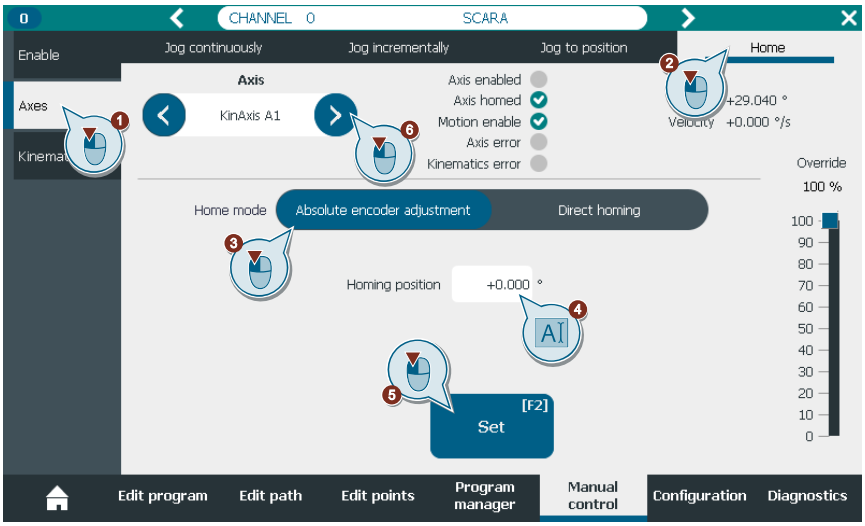
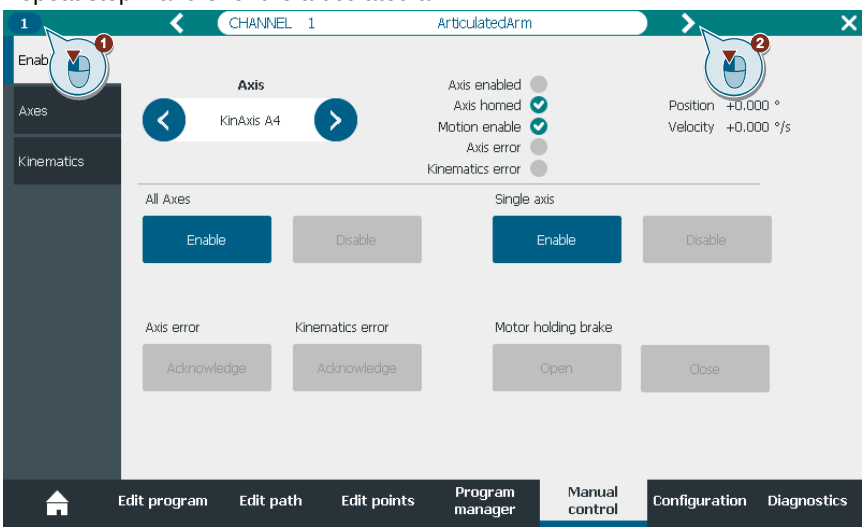
3.3 Manual control

3.3.1 Home

After the connection between the HMI and the PLC is established, it must be checked if the axes of the Scara roboter, conveyor belts and articulated arm are homed. Therefore, following steps must be done:

Table 3-3 Homing axes

No.	Action
1.	Login as administrator: Username → admin Password → Admin 
2.	Select „Manual control“ and enable all axes. 

No.	Action
3.	Home all axes to 0,0° or rather 0,0mm. 
4.	Repeat step 2 and 3 for the articulated arm. 

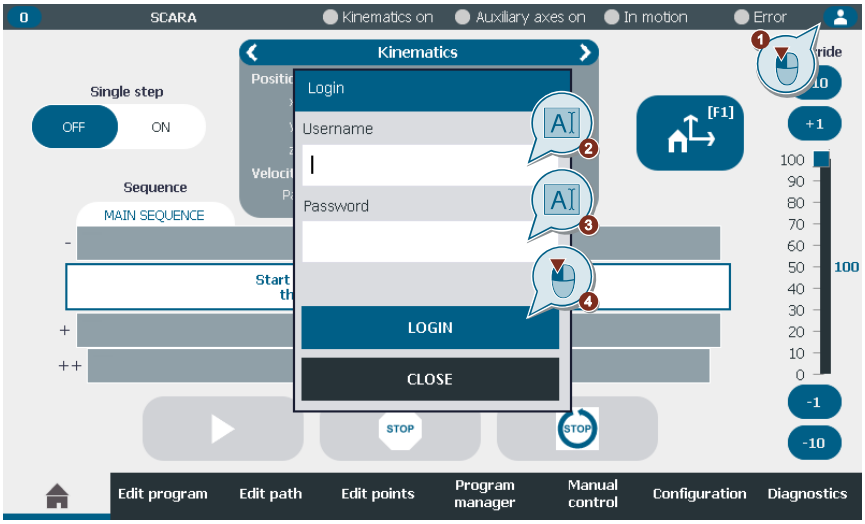
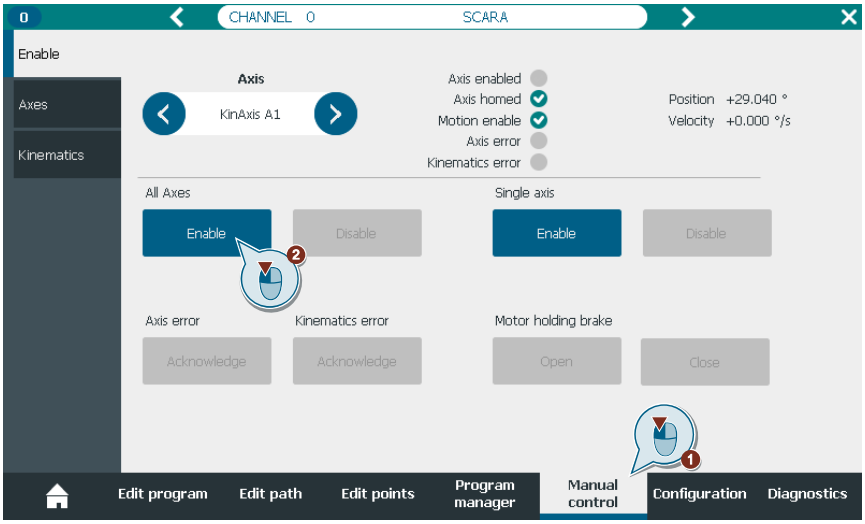
3.3.2 Jog

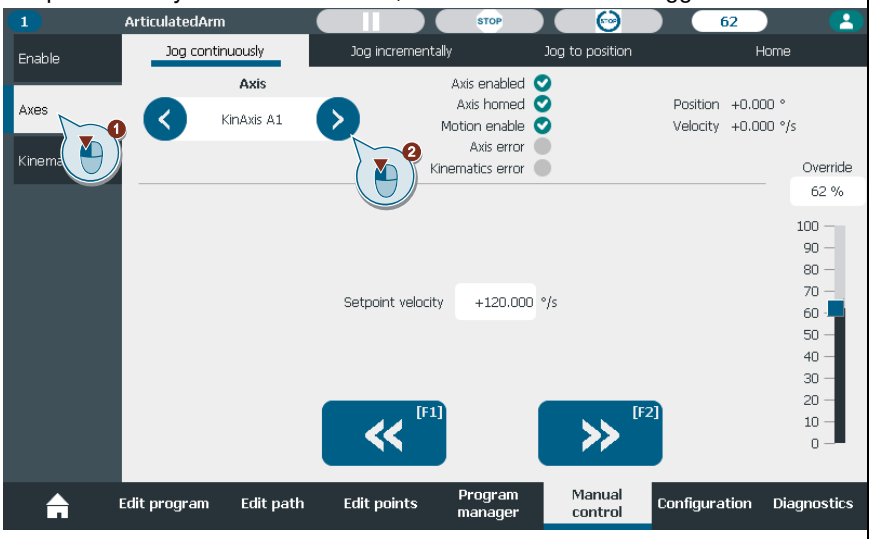
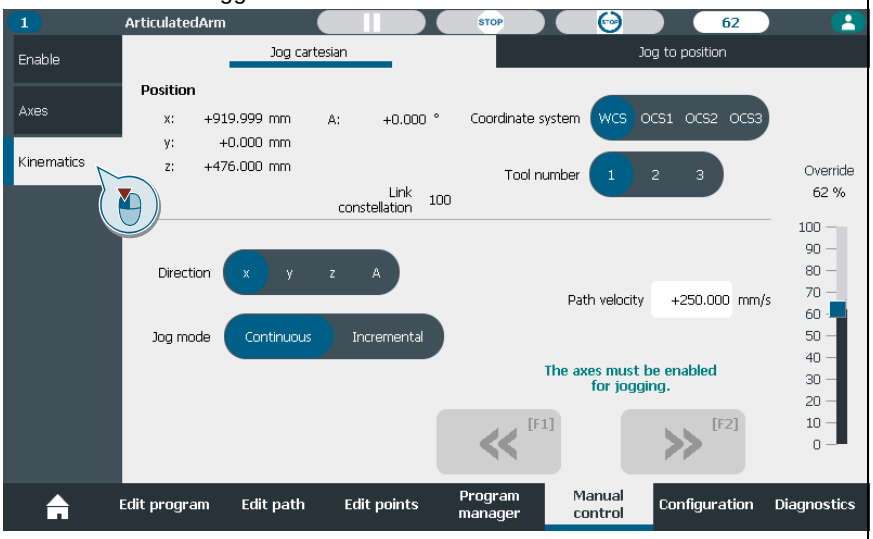
With SKI it is possible to jog a single axis or the kinematics at once:

- Jog a single axis (incremental / continuous) or jog to a target position
- Jog the kinematics (incremental / continuous), jog to a Cartesian target position or to a point from the point table with linear or sPTP motion

Therefore, following steps must be done:

Table 3-4 Jog

No.	Action
1.	Login as administrator: Username → admin Password → Admin 
2.	Select „Manual control“ and enable all axes. 

No.	Action
3.	To jog a single axis, select “Axes” and for the desired type of jog command select the corresponding tab. After selecting the desired axis and defining the “Setpoint velocity” and the “Override”, the movement can be triggered. 
4.	To jog a kinematic, select “Kinematics” and for the desired type of jog command select the corresponding tab. After configuring the jog command (e.g. “Coordinate system”), defining the “Path velocity” and the “Override”, the movement can be triggered. 

3.3.3 Teach and configure points

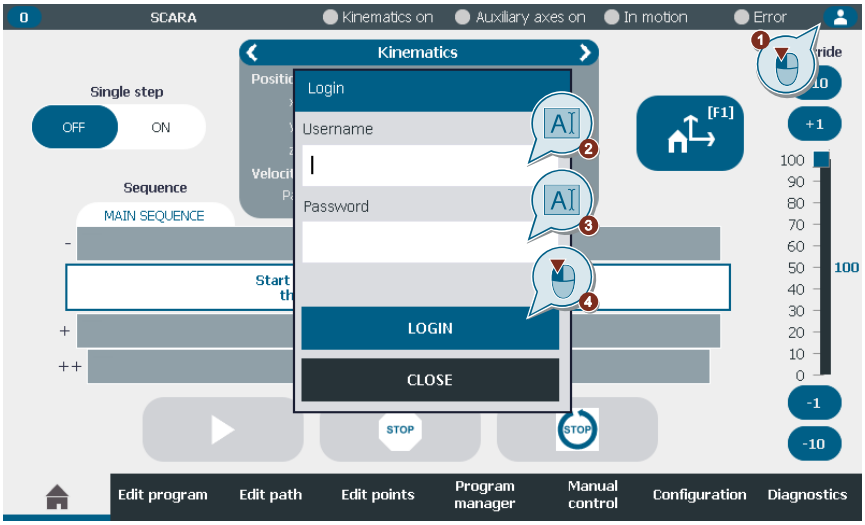
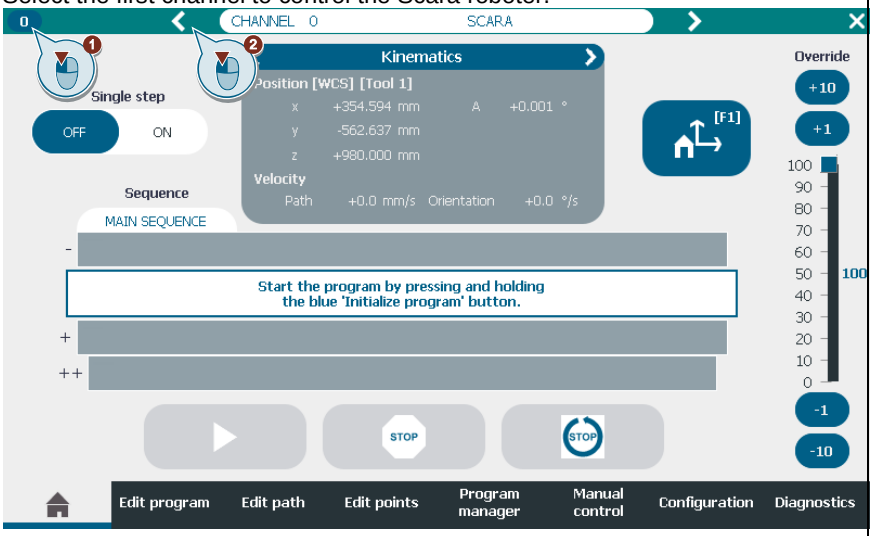
At the tab “Edit points” a list of points can be specified. These points can then be used as references in kinematics Motion Control commands when creating programs. This type of command specification has the advantage that points can be modified afterwards and the program is automatically updated by the reference.

A specific name can be assigned to each point, e.g. “place position”. You can change the points later to make adaptions. The point reference in the automatic program remains.

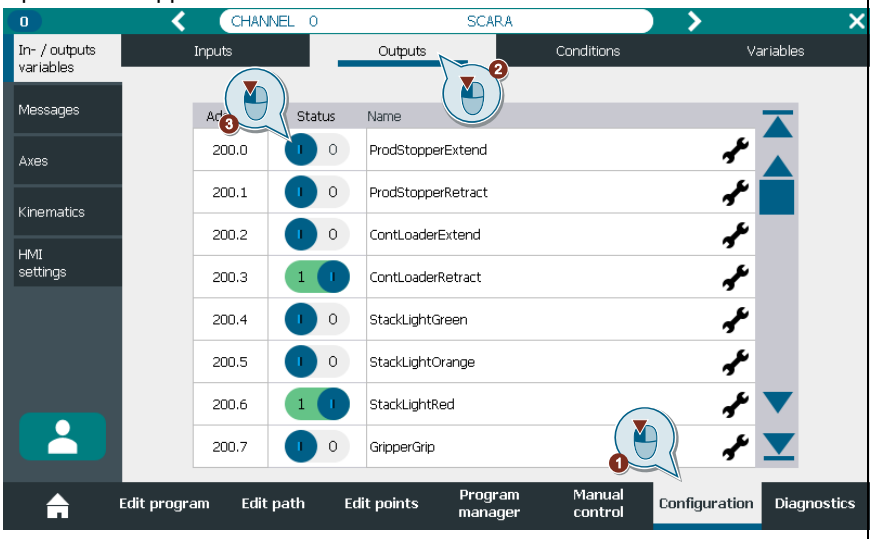
The points can be either defined by entering the coordinates manually or jogging the kinematics and saving its current position.

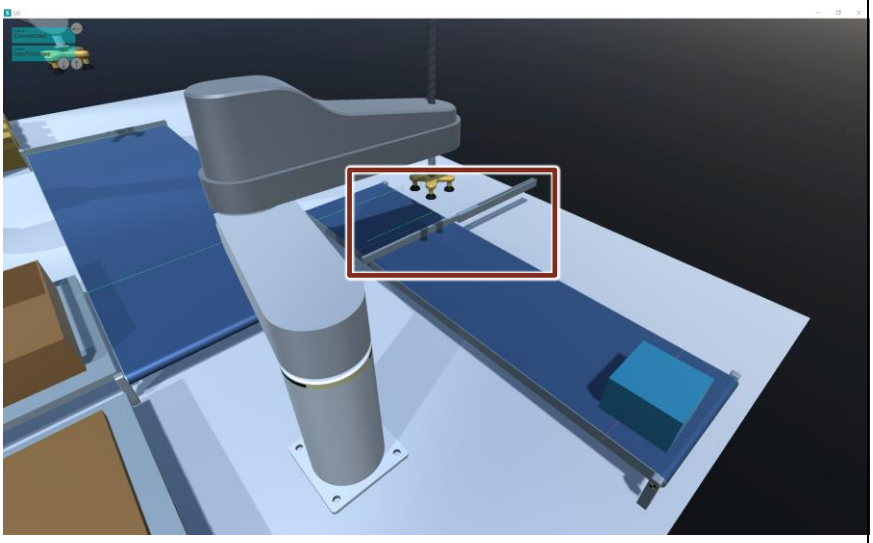
As an example, follow these steps:

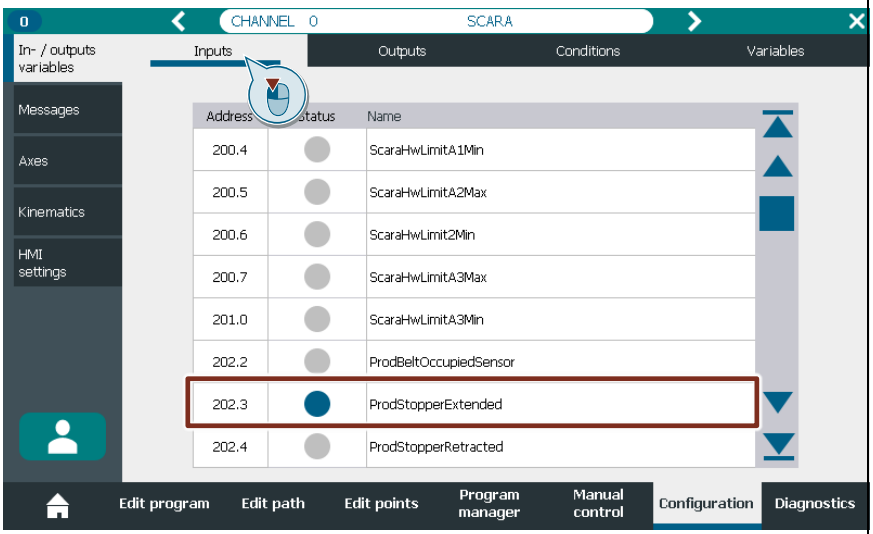
Table 3-5 Teach and configure points

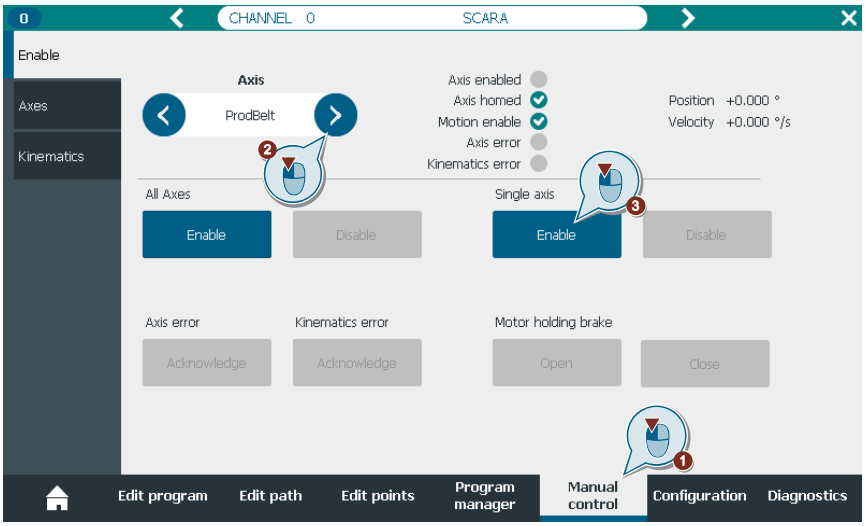
No.	Action
1.	Login as administrator: Username → admin Password → Admin 
2.	Select the first channel to control the Scara roboter. 

No.	Action
3.	Switch to “Configuration” and switch to the tab “Outputs”. With selecting and deselecting “ProdStopperExtend” the stopper is extended. The corresponding input “ProdStopperExtended” is set.

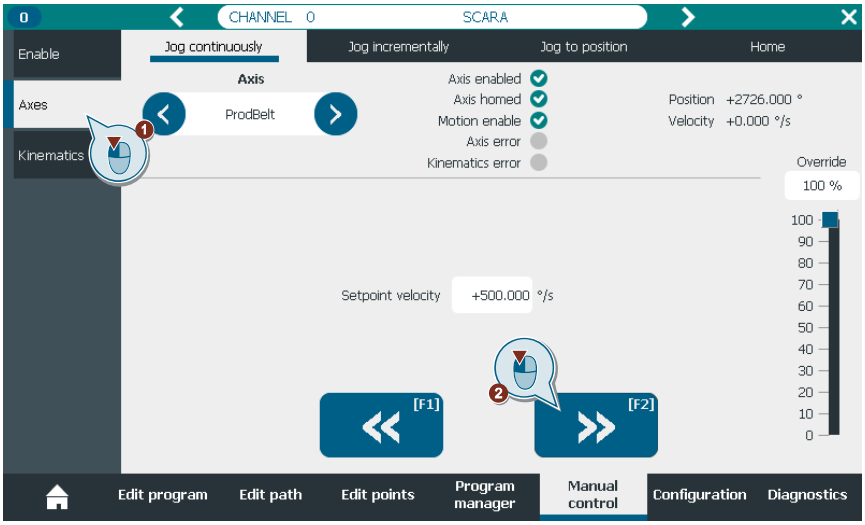


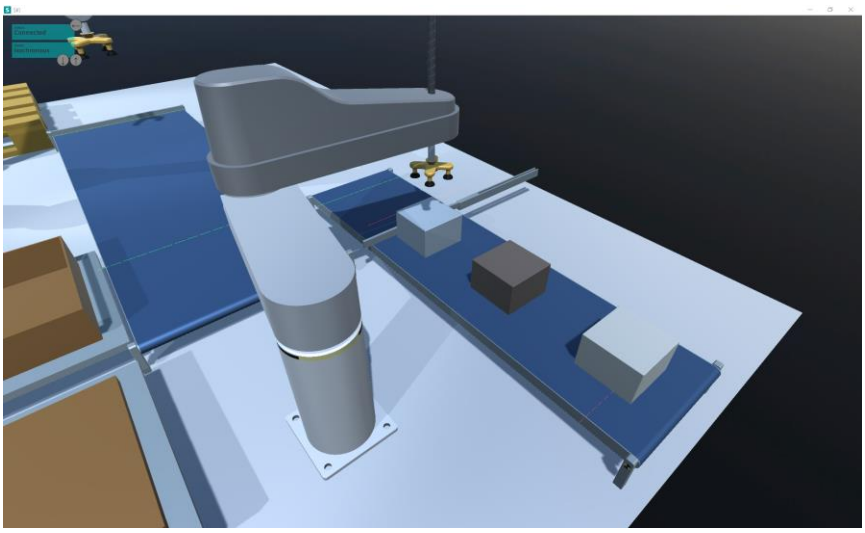


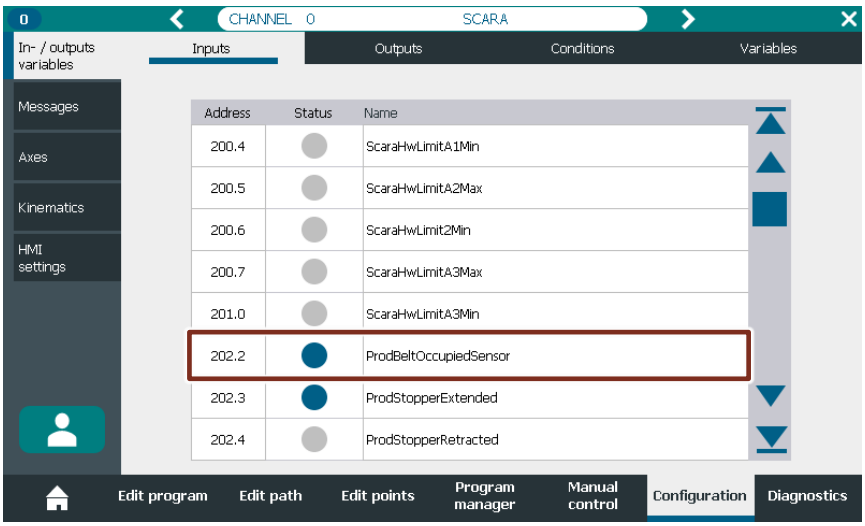


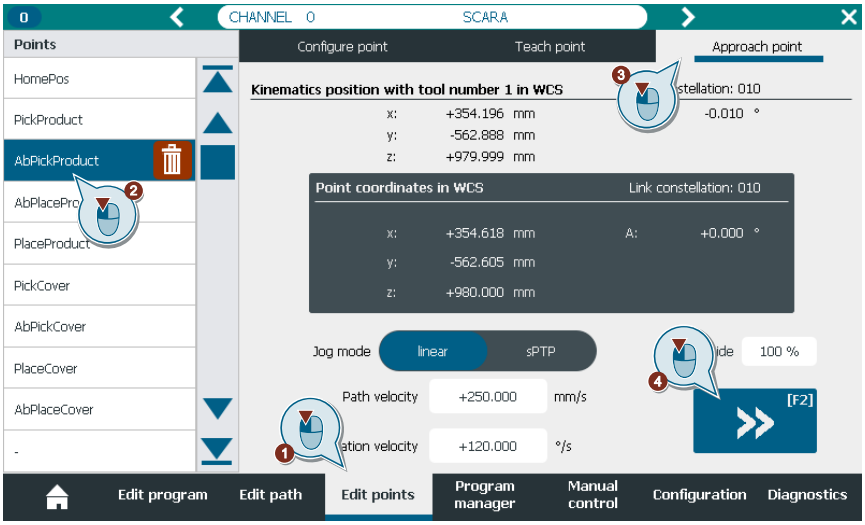
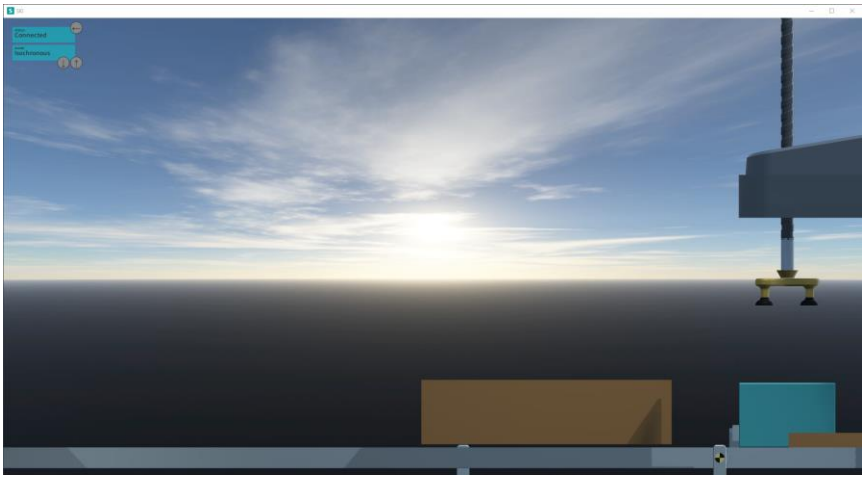
No.	Action
4.	Switch to “Manual control”, select “ProdBelt” and enable the axis. 

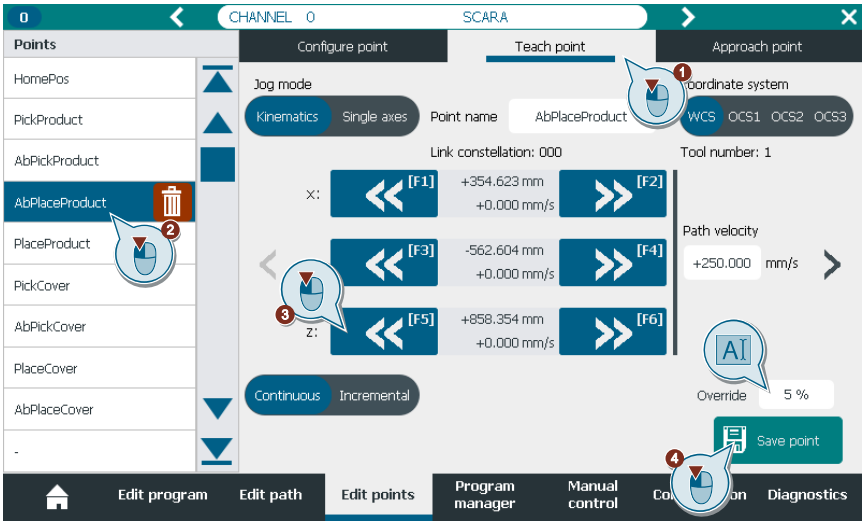
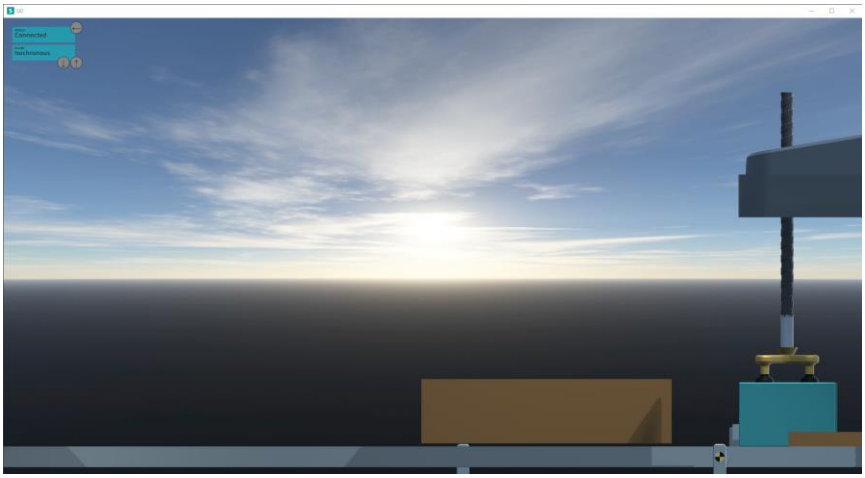
No.	Action
5.	Select “Axes” and jog the belt until the first product reaches the stopper. The corresponding input signal “ProdBeldOccupiedSensor” is set.







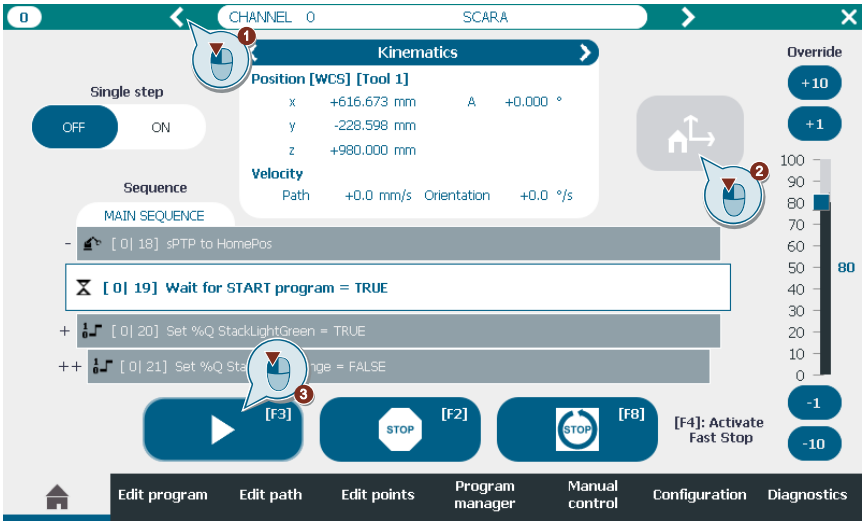
No.	Action
6.	Switch to “Edit points”, select the point “AbPickProduct”, switch to the tab “Approach point” and move the Scara roboter to the selected point. 
7.	Use the “Space” key on the keyboard, switch to the shown standard view: 

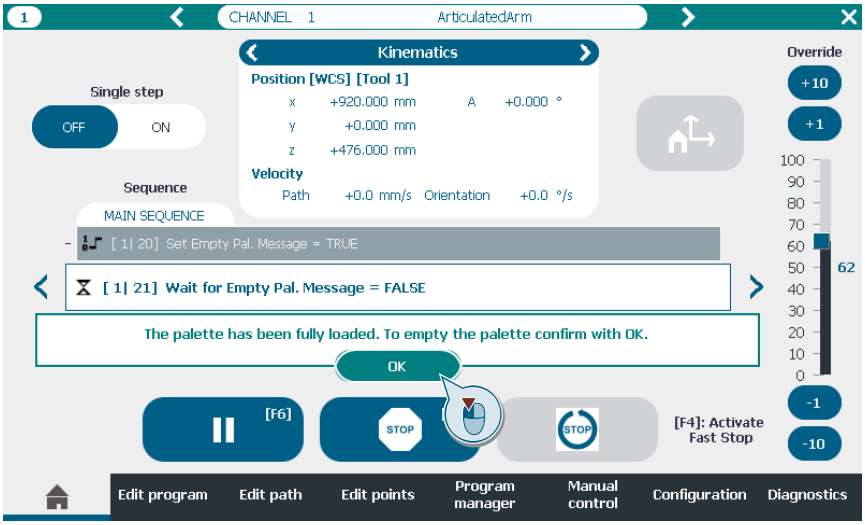
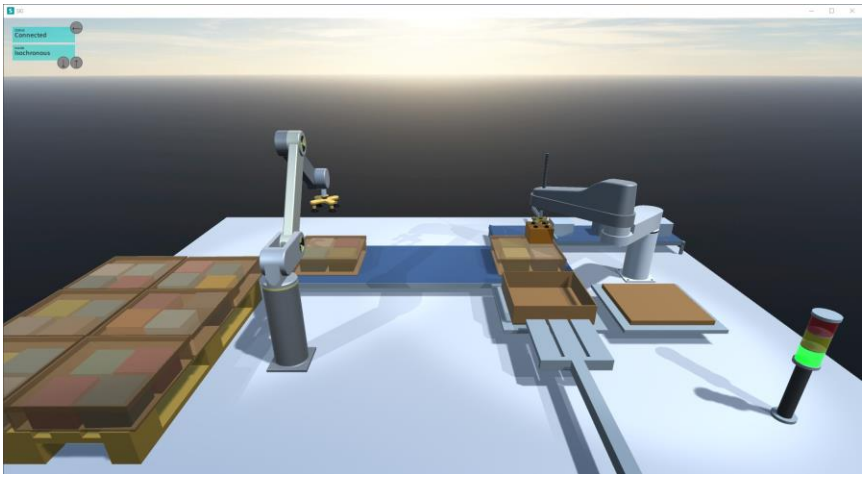
No.	Action
8.	Switch to the tab “Teach point” and select the point “AbPlaceProduct”. Move the zAxis in negative z direction until the gripper touches the product. The press “Save point”. It could be useful to reduce the “Override”.  
9.	Select the point “AbPickProduct” again, switch to the tab “Approach point” and move the Scara roboter to the selected point.

3.4 Operation

This application example provides a sequence for continuous operation, where both robots are involved (3.2). To start this sequence, following steps needs to be done:

Table 3-6 Continuous operation

No.	Action
1.	Select the channel of the articulated arm and press “Initialize program” until the axes stop automatically. Then press “Start” and the continuous operation of the articulated arm will start when the first box is detected by the input “ContAtPalletizingSensor”. 
2.	Select the channel of the Scara roboter and press “Initialize program” until the axes stop automatically. Then press “Start” and the continuous operation of the Scara roboter will start with detecting a product at the input “ProdBeldOccupiedSensor”. 

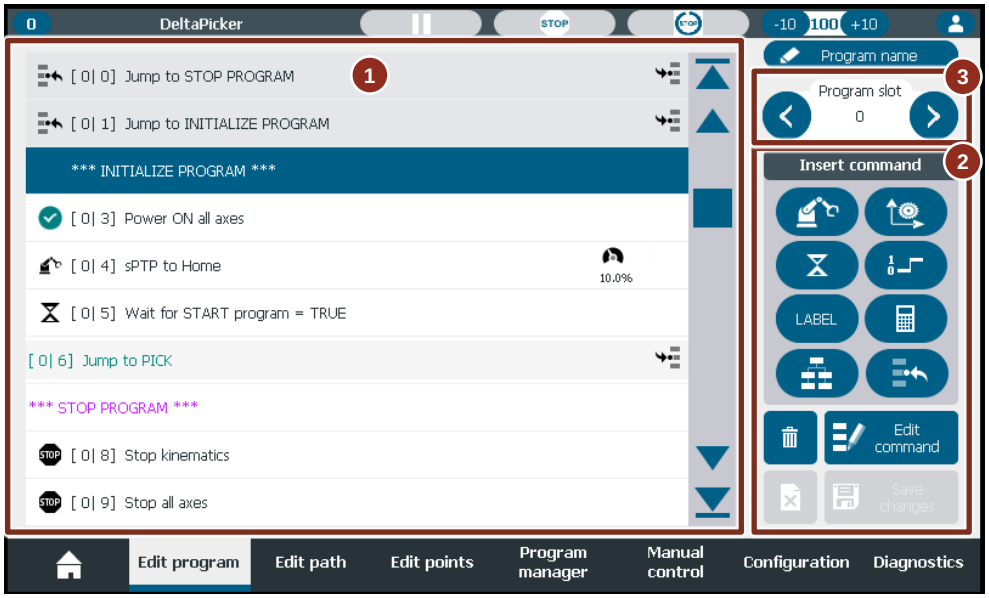
No.	Action
3.	The sequence is running automatically, until the palette is filled with 6 boxes. Then a message on the channel of the articulated arm occurs. With confirming this message, the palette is emptied and the sequence goes on.  

3.5 Programming pick and place

The program editor can be used to create a completely new program or to adapt an existing program.

1. The command list is displayed on the left side. It displays a section of up to ten configured commands of the selected program slot. To select a command the corresponding line must be pressed.
2. The command bar includes different commands to structure the program and move the axes. The commands are described in the following chapters.
3. The displayed program slot can be selected by pressing the right or left arrow buttons.

Figure 3-2: Overview program editor



To insert a command, select a command line from the program and choose a command from the command bar that can be added. After saving the changes of the command configuration the command is inserted. To edit an already configured command, select it in the table and then press the ‘Edit command’ button.

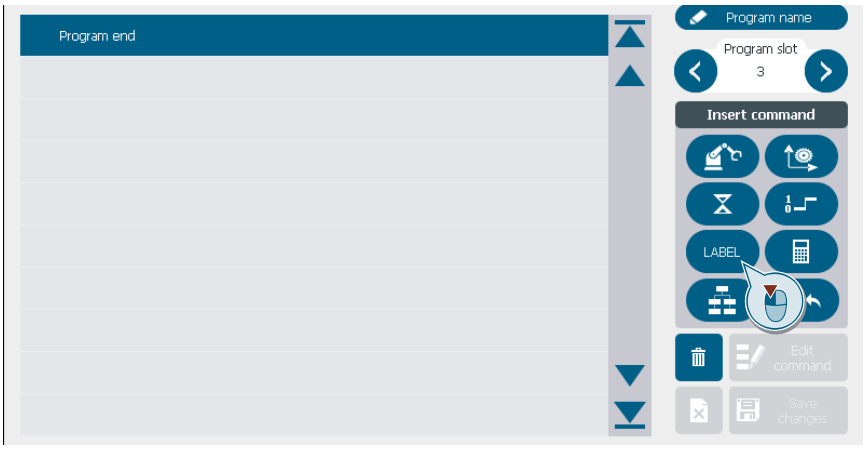
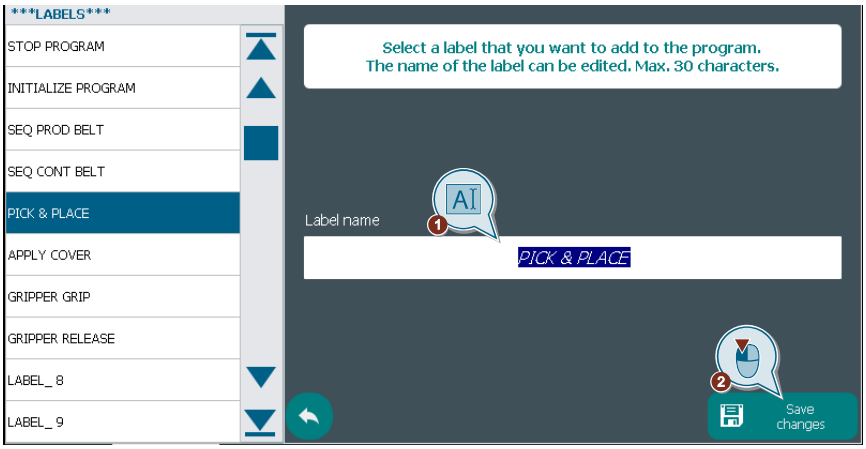
To modify the command list, the user can access additional auxiliary functions, such as copy and paste, delete, or deactivate a command. These functions are grouped in a separate submenu. To open this editing menu, any line at the program list must be pressed for at least 3 seconds.

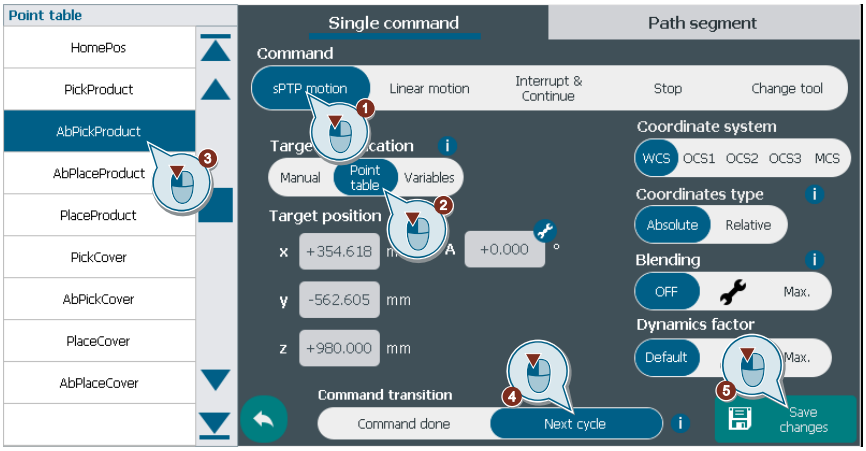
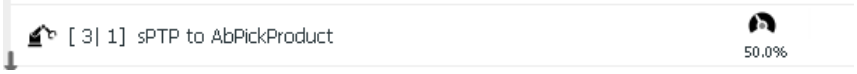
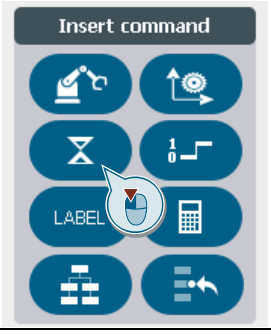
Programming example

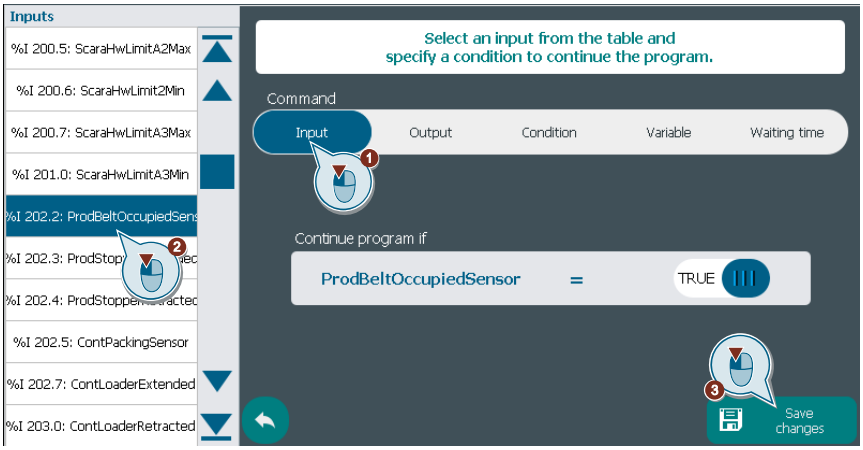
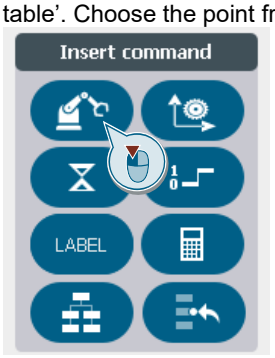
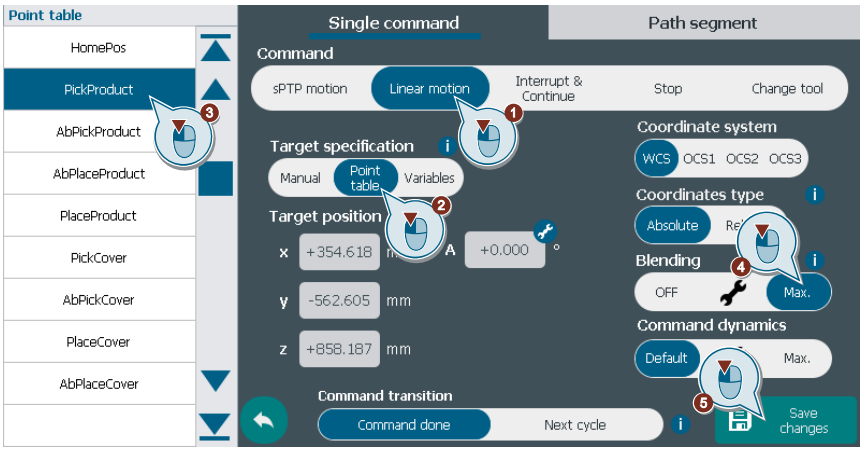
In the following table the programming of a Pick and Place is explained step by step. If you want to follow the instructions, you can use the provided project as a basis. Delete the program slot 3 in the 1st channel by clicking on the ‘Trash can’ icon and selecting ‘Delete program slot’. Now you can program the Pick and Place yourself.

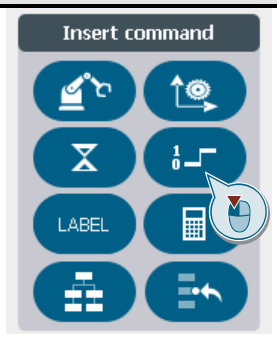
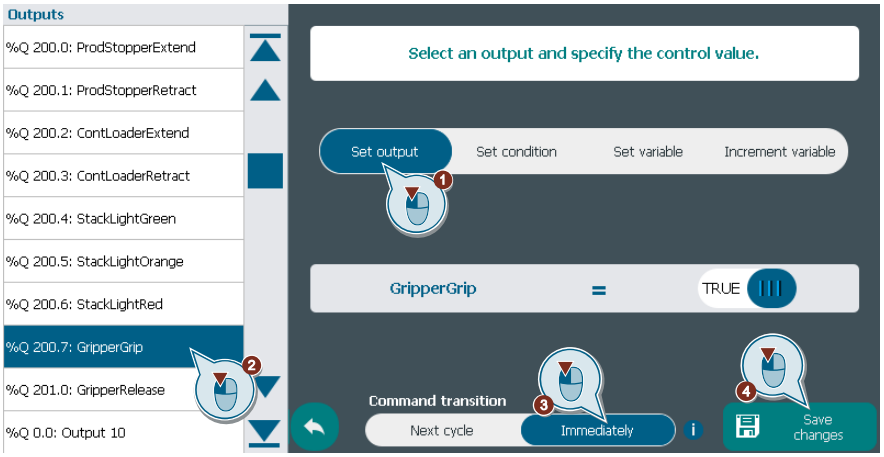
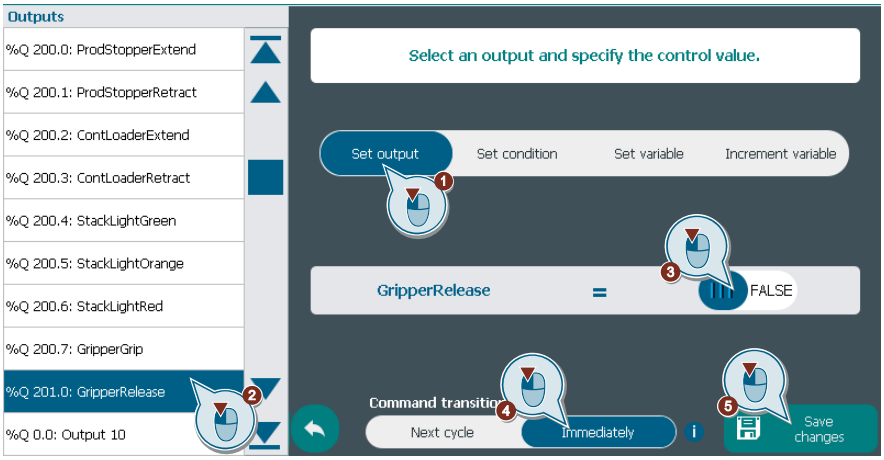
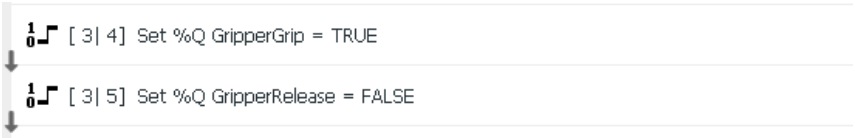
After you have programmed the example below the Scara will pack one product in each box.

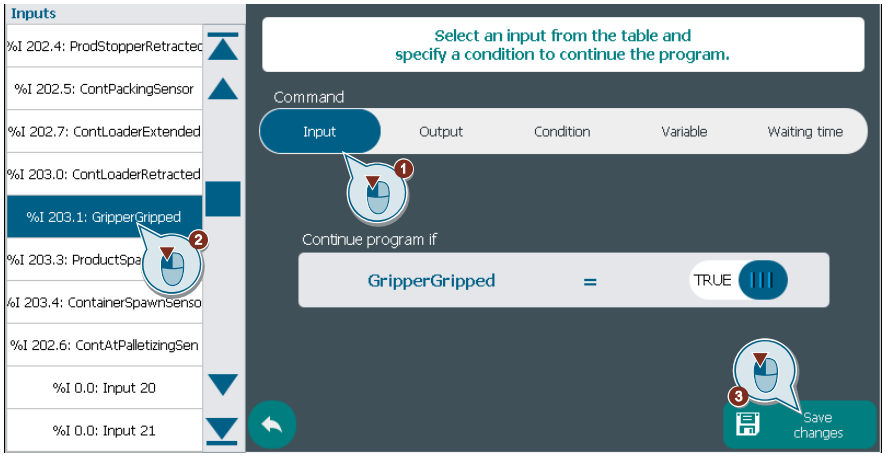
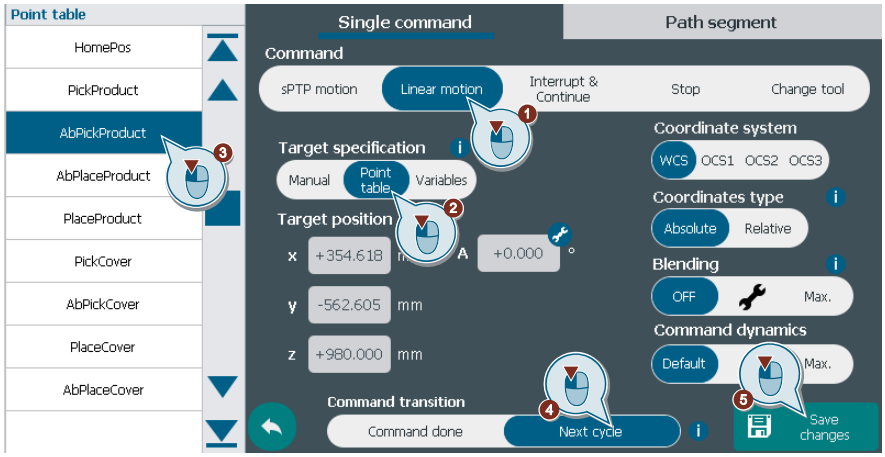
Table 3-7 Pick & Place

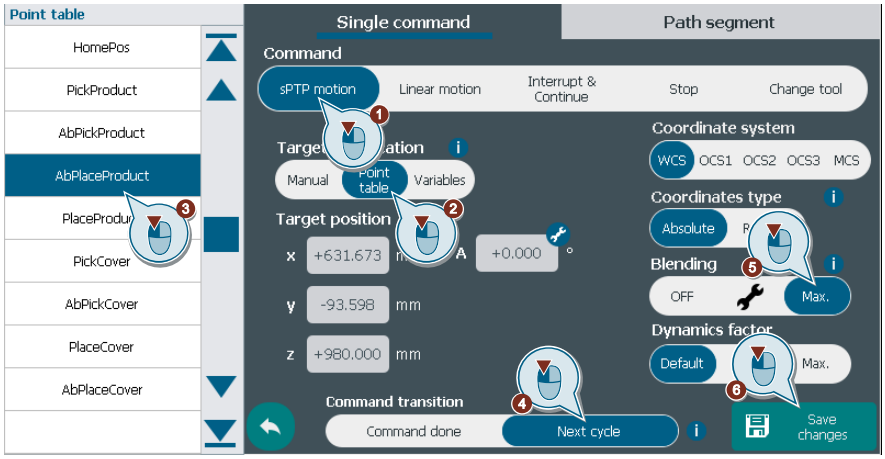
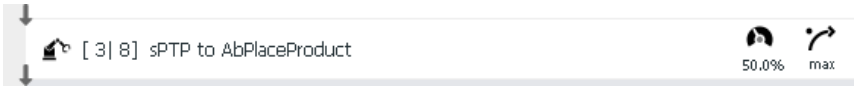
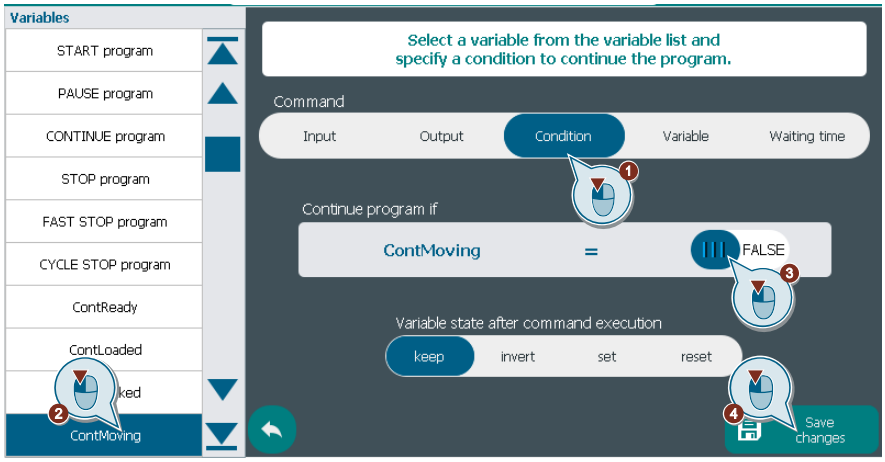
No.	Action
1.	Create and insert a new label ‘PICK & PLACE’ in the program slot 3 in the 1st channel.   **Result:** *** PICK & PLACE ***

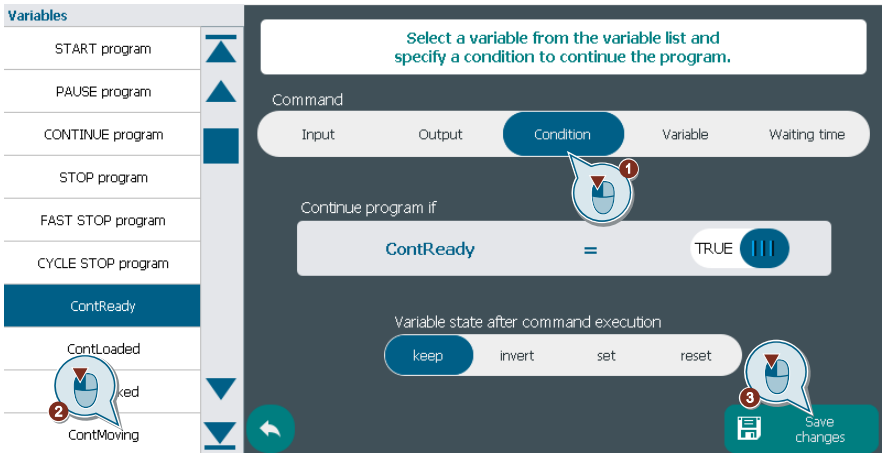
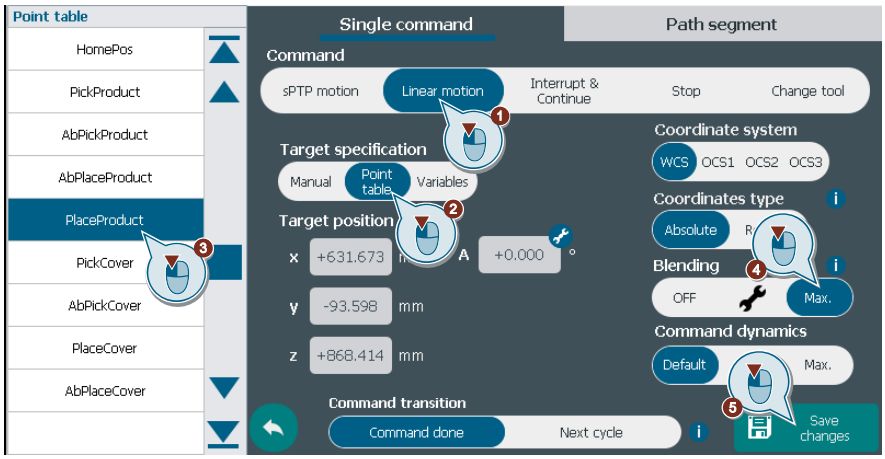
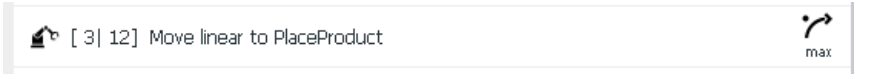
No.	Action
2.	Add a kinematics movement command: sPTP to the point ‘AbPickProduct’. Open the kinematics movements commands. sPTP is already selected. Click on ‘Point table’. Select the point from the point table. Set the command transition to ‘Next cycle’ and save the command.   **Result:** 
3.	Add a wait command: Wait until a product is ready to be picked ‘%I ProdBeltOccupiedSensor’ = TRUE 

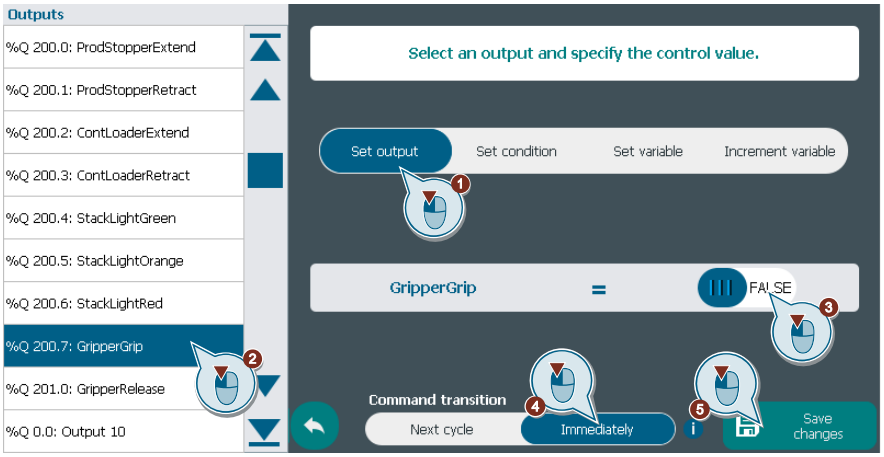
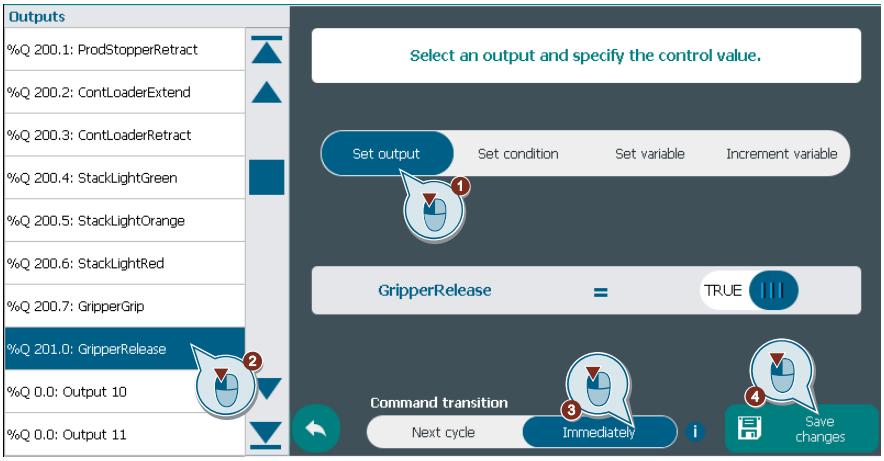
No.	Action
	 **Result:** 
4.	Add a kinematics movement command: Move linear to the point ‘PickProduct’. In the configuration of the kinematics command select ‘Linear motion’ and ‘Point table’. Choose the point from the point table. Configure the blending to ‘Max.’.   **Result:** 
5.	Add 2 commands: Activate the gripper by setting ‘%Q GripperGrip’ = TRUE and ‘%Q GripperRelease’ = FALSE. Set the command transition to ‘Immediately’.

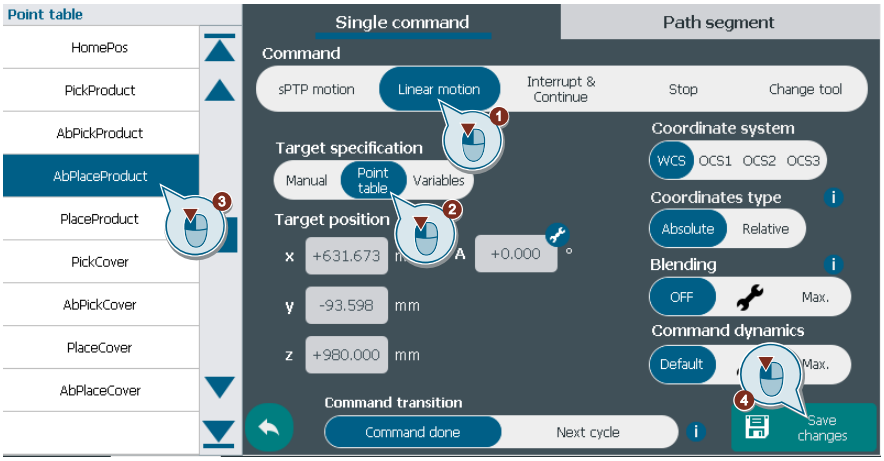
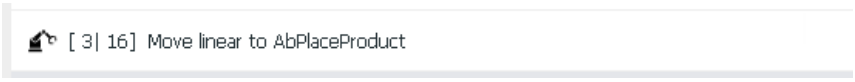
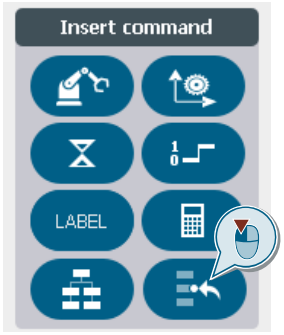
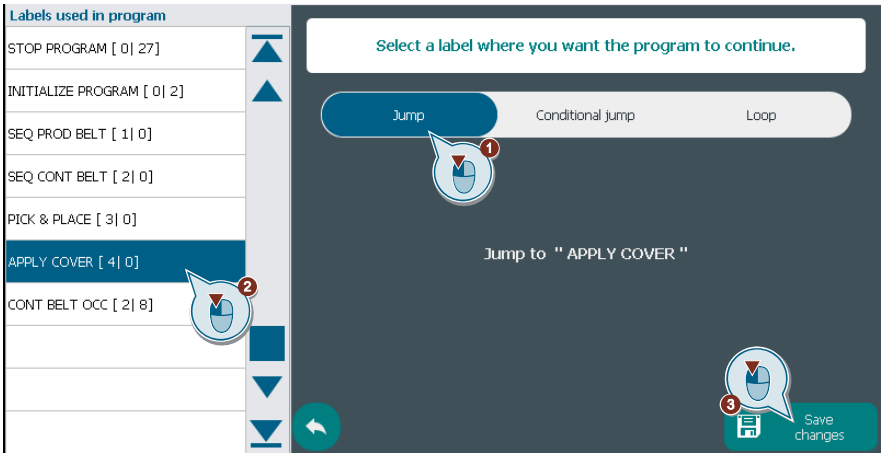
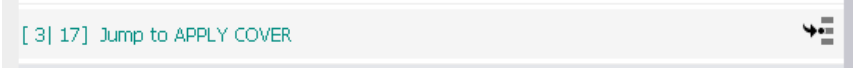
No.	Action
	   **Result:** 
6.	Add a wait command: Wait for the feedback %I GripperGripped = TRUE.

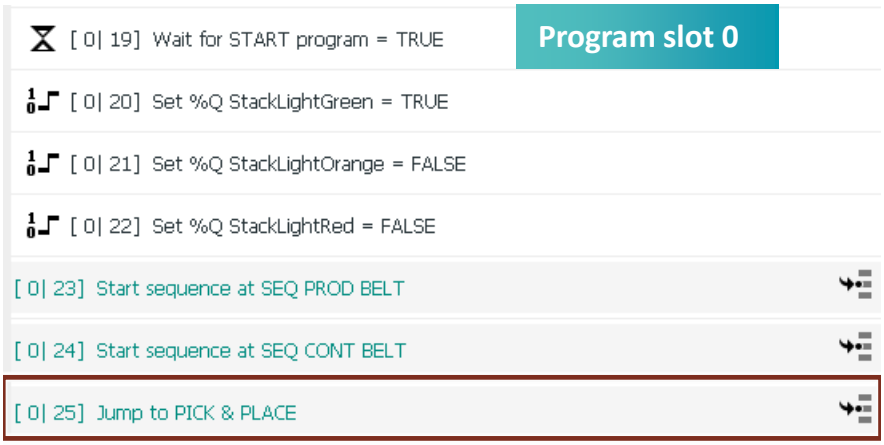
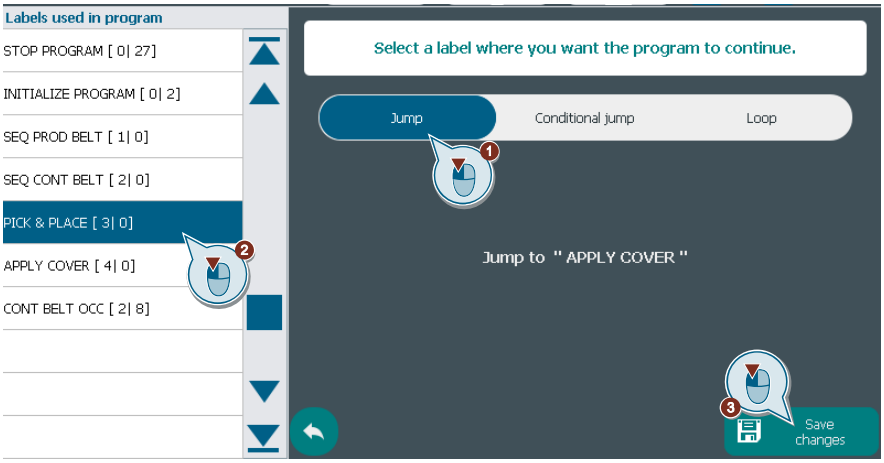
No.	Action
	 **Result:** 
7.	Add a kinematics movement command: Move linear to the point ‘AbPickProduct’. Set the command transition to ‘Next cycle’.  **Result:** 
8.	Add a kinematics movement command: sPTP to the point ‘AbPlaceProduct’. Set the command transition to ‘Next cycle’ and configure the Blending as ‘Max.’.

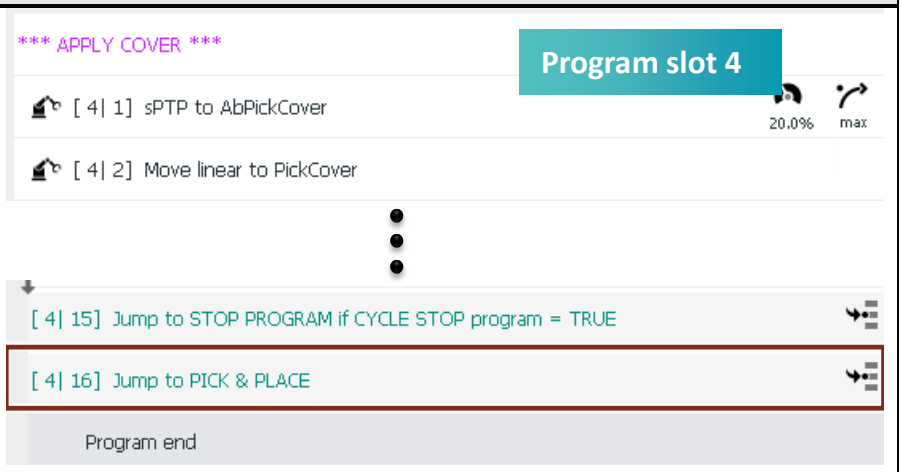
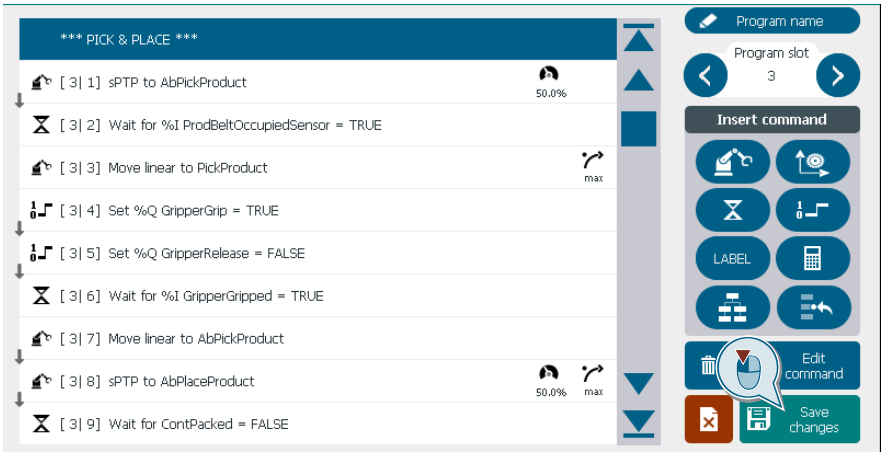
No.	Action
	 **Result:** 
9.	Wait until the place position is available. In this case the container belt has to be stopped and an empty container has to be on the container belt. Add 3 wait commands: Wait for the conditions ContPacked = FALSE, ContMoving = FALSE and ContReady= TRUE.  

No.	Action
	 **Result:** 
10.	Add a kinematics movement command: Move linear to the point ‘PlaceProduct’.  **Result:** 
11.	Add commands to deactivate the gripper: Deactivate the gripper by setting ‘%Q GripperGrip’ = FALSE and ‘%Q GripperRelease’ = TRUE. Set the command transition to ‘Immediately’.

No.	Action
	  **Result:** [3| 13] Set %Q GripperGrip = FALSE [3| 14] Set %Q GripperRelease = TRUE
12.	Add a wait command: Wait for the feedback %I GripperGripped = FALSE.  **Result:**

No.	Action
	
13.	Add a kinematics movement command: Move linear to the point ‘AbPlaceProduct’.  **Result:** 
14.	Add a Jump command: Jump to the label APPLY COVER.   **Result:** 
15.	Insert a Jump command after the initialization routine in program slot 0. After the command ‘Wait for START program = TRUE’ and starting the parallel sequences

No.	Action
	insert a jump to the Label ‘PICK & PLACE’.  **Result:** 
16.	Insert a Jump command to the Label ‘PICK & PLACE’ after the ’APPLY COVER’ segment in program slot 4. That way the program will loop through packing a product in a container and then applying the cover.  **Result:**

No.	Action
	
17.	Save the program by clicking ‘Save changes’ on the bottom right corner of the program editor. 

4 Appendix

4.1 Service and support

Industry Online Support

Do you have any questions or need assistance?

Siemens Industry Online Support offers round the clock access to our entire service and support know-how and portfolio.

The Industry Online Support is the central address for information about our products, solutions and services.

Product information, manuals, downloads, FAQs, application examples and videos – all information is accessible with just a few mouse clicks:

support.industry.siemens.com

Technical Support

The Technical Support of Siemens Industry provides you fast and competent support regarding all technical queries with numerous tailor-made offers – ranging from basic support to individual support contracts.

Please send queries to Technical Support via Web form:

siemens.com/SupportRequest

SITRAIN – Digital Industry Academy

We support you with our globally available training courses for industry with practical experience, innovative learning methods and a concept that’s tailored to the customer’s specific needs.

For more information on our offered trainings and courses, as well as their locations and dates, refer to our web page:

siemens.com/sitrain

Service offer

Our range of services includes the following:

- Plant data services
- Spare parts services
- Repair services
- On-site and maintenance services
- Retrofitting and modernization services
- Service programs and contracts

You can find detailed information on our range of services in the service catalog web page:

support.industry.siemens.com/cs/sc

Industry Online Support app

You will receive optimum support wherever you are with the "Siemens Industry Online Support" APP. The app is available for iOS and Android:

support.industry.siemens.com/cs/ww/en/sc/2067

4.2 Industry Mall

The Siemens Industry Mall is the platform on which the entire siemens Industry product portfolio is accessible. From the selection of products to the order and the delivery tracking, the Industry Mall enables the complete purchasing processing – directly and independently of time and location:
mall.industry.siemens.com

4.3 Application support

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4.4 Links and literature

Table 4-1

No.	Topic
\1\	Siemens Industry Online Support https://support.industry.siemens.com
\2\	Link to this entry page of this application example https://support.industry.siemens.com/cs/ww/en/view/109802248
\3\	SIMATIC SIMIT Simulation Platform https://support.industry.siemens.com/cs/ww/de/view/109746429
\4\	SIMIT-Unity coupling https://support.industry.siemens.com/cs/ww/de/view/109769816

4.5 Change documentation

Table 4-2

Version	Date	Modifications
V1.0	12/2022	First version